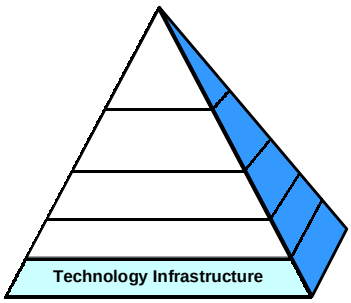
1.12.6 FEMA Technology Infrastructure

1.12.6.1 Introduction



This section of the *FEMA IT Architecture* identifies and describes the underlying information technology infrastructure. The underlying technology infrastructure is described in terms of reusable IT *architectural components* that provide functional capabilities and services that can be integrated into FEMA enterprise-wide and program-centric systems. Architectural aspects associated with the high-level *wiring diagram* of communications and networks are addressed in Section 3.

1.12.6.2 Principles for Enterprise Integration and Re-Use of Architectural Components

An *architectural component* is defined as a high-level building block or piece of a larger system that can be used and re-used across multiple systems in a cost effective and standardized manner. Architectural components are sometime referred to as *middleware* or the basic building blocks of IT systems. Architectural components comprise the basic FEMA IT systems and network infrastructure. Architectural components broadly include: information technology standards, hardware, networks, software, processes, environmental factors, partnerships and relationships, data stores, documents, common business function requirements, technologies, and tools that are used to build systems or that are used within a system.

This section identifies and discusses a number of common and reusable information technologies and tools that have potential to become standardized and reusable architectural components. Consistent with the IT architectural model presented in Section 1.11, the technology infrastructure is intended to directly support FEMA's business processes.

Section 1.8 of this *FEMA IT Architecture* document set forth the architectural principle that: *"Any proposed IT development activity shall re-use existing defined enterprise-wide architectural components unless the components can be demonstrated to be inadequate to the requirements to the satisfaction of the CIO and the IRB."* This principle will help drive more cost effective systems development and is essential for achieving increased interoperability and standardization. It also provides a mechanism for highlighting any deficiencies in the definition or implementation of common architectural components across the FEMA IT infrastructure.

1.12.6.3 Leveraging Technology Developments in Other Agencies and Industry

The *FEMA IT Architecture* has a major goal of achieving increased interoperability with FEMA's business partners. FEMA seeks to leverage technology developments in other agencies and industry. FEMA will monitor the work of the CIO Council, industry groups, voluntary organizations, universities, and its business partners.

1.12.6.4 Identification and Synopsis of FEMA Enterprise IT Architectural Components and Services

Figure 1-16 depicts how a FEMA enterprise-wide system or a program-centric system could use and reuse common information technology architectural components.

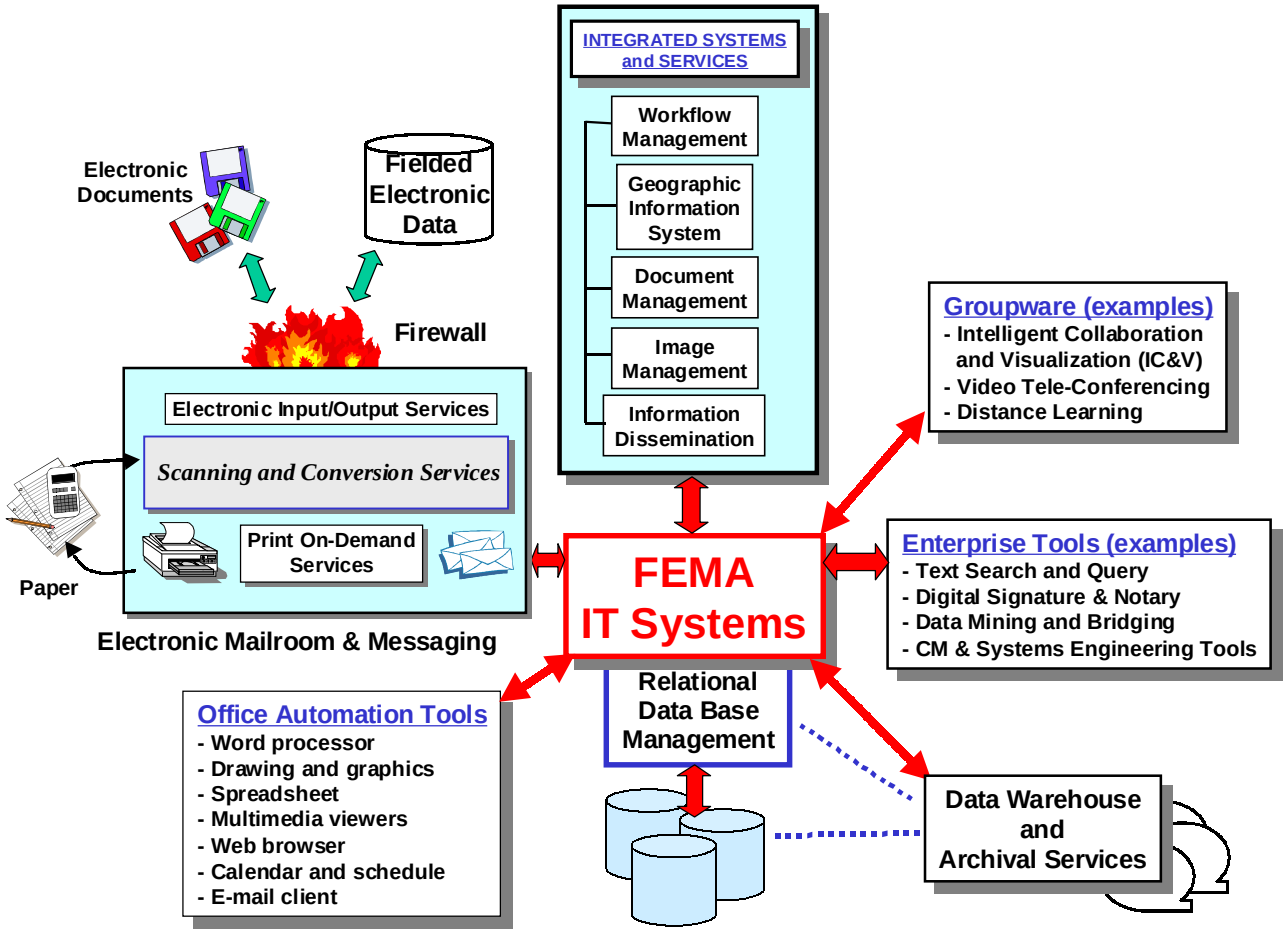


Figure 1-16. Identification of Reusable Architectural Components for FEMA IT Systems

During the structured interview process, a significant number of organizational elements identified a common set of IT architectural needs that are identified in Figure 1-16.

1.12.6.5 High-Level Architectural Considerations

It is important to note that all of the information technology services and needs identified in the structured discussions above are fairly generic and are not specified in detailed systems engineering or design terms. This statement reflects the fact that the purpose of the *FEMA IT Architecture* is to define a ***technology vision***, not a detailed systems engineering design. It makes good economic sense, and advances the objective of interoperability, for the FEMA ITS Directorate to design and develop these capabilities as common, enterprise-wide, standardized components. The programmatic intent is to develop standardized architectural components, which can be re-used across both enterprise-wide and program-centric IT systems. To the maximum

extent practicable, FEMA also desires to leverage IT investments and technology insertion activities in other Federal agencies.

Need to Conduct Business Case Analysis. Another important point to make at this juncture is that some of the architectural components and technology implied by Figure 1-16 may not make sound business sense given the current state of FEMA networks. For example, advanced groupware technologies such as: intelligent collaboration and visualization of very large GIS data sets; integrated voice, video, and data applications; distributed interactive simulation (DIS), and distance learning (incorporating virtual reality technology) are widely accepted to be bandwidth intensive in large-scale distributed operations. The current FEMA network only has limited capability to support some of these advanced technologies today. Accordingly, it is important to realize that Figure 1-16 merely provides an architectural vision or framework for discussing **how** FEMA IT systems might be structured to use common architectural components. Business case analyses for the more demanding architectural components clearly need to be accomplished before any actual implementation.

Need to Integrate with Security Architecture. Another important point is that IT architectural components need to be developed and integrated in consideration of a robust security architecture, which provides important services including confidentiality, data integrity, originator authentication, assured service availability, and non-repudiation.

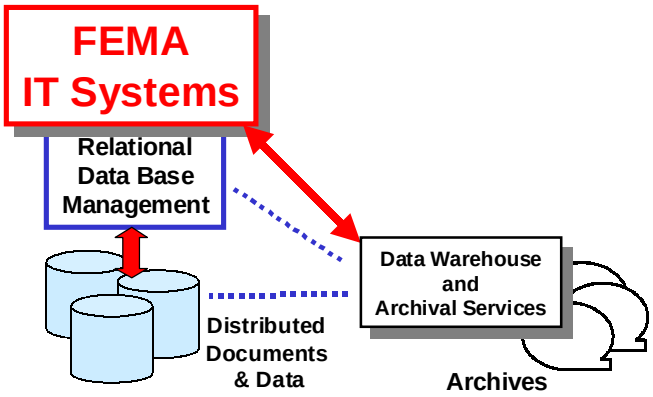
NEMIS as an IT Architecture Development Environment. FEMA notes that many of the desired capabilities and information technology needs that were identified during the structured discussions are currently under development or are under active investigation by the NEMIS Project. Thus, NEMIS provides FEMA with an important IT architecture breeding, testing, and integration environment for a number of the concepts.

Major Architectural Components. The remainder of this section briefly identifies and describes the major IT architectural components that were identified during the structured discussion process. This discussion follows the layout of Figure 1-16 and addresses the major elements. The architectural framework provides IT systems with access to the following:

- **Digital Library Services** includes access to distributed documents and data bases, data warehouse, and archives via an enterprise-wide relational data base management system. The current FEMA relational data base standard is Oracle. The latest release of Oracle is Oracle 8. Oracle 8 is an object-relational data base management system, which provides improved handling of large objects typically seen in a distributed digital library environment.
- **Integrated Enterprise-Wide Systems and Services** such as workflow, GIS, document management system, image management system, and information dissemination services.
- **Bi-Directional Electronic Mailroom and Messaging Services** including 24/7 support for print on-demand and mail; scanning and conversion of paper-based documents; and electronic I/O services for processing, handling, validating, and receipting of electronic documents and fielded electronic data transactions.
- **Office Automation Tools**.
- **Enterprise-Wide Standard Tools** such as text search, digital notary, data mining, print on-demand, rendering and display, etc.
- **Groupware.** Within this *FEMA IT Architecture*, groupware is broadly defined as software or middleware that facilitates intelligent collaboration and visualization activity on digital library objects distributed across the enterprise. Groupware may take advantage

of enterprise tools, distributed data and documents, applications, models and simulations, mailroom and messaging services, etc. In reference to Figure 1-16, groupware might also support a Java-based Web interface.

1.12.6.6 Digital Library Services



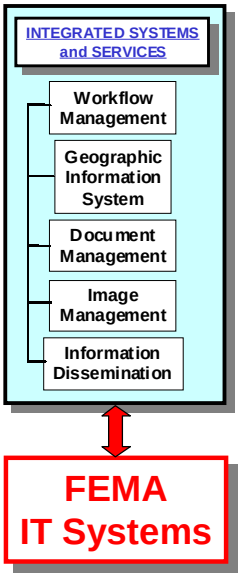
The target *FEMA IT Architecture* provides for development of digital library services managed by a relational data base management system. At the current time, NEMIS digital library services are mostly text-based.

Based on structured discussions with FEMA organizational elements, a potential requirement exists to extend digital libraries services to manage other complex objects, including mixed-mode compound documents and data sets (e.g., hyperlinked text, images, graphics, multimedia, spreadsheets, interactive GIS, etc.) as illustrated in the data model shown in Figure 1-15. This effort may require migration to an object-relational data base management system such as Oracle 8 in the future.

The digital library support services also need to consider providing support for a data warehouse and archives for legal and regulatory purposes as well as backup and recovery. Special attention will need to be placed on services to maintain long term document and data integrity within the digital library. Also, with NEMIS as the organizational lead, FEMA will strive towards standardization and harmonization of enterprise-wide data dictionaries.

As the FEMA network evolves with improved Quality of Service, the digital library can become more interactive and can be integrated with groupware services such as integrated voice, video, and data applications; distributed planning tools; and distance learning tools. Development of robust and effective digital library services across the enterprise will need to carefully consider integration of other architectural components such as: correspondence and action tracking, document management, image management, electronic mailroom and legacy data capture, multimedia, and text search components.

1.12.6.7 Integrated Enterprise-Wide Systems and Services



Integrated enterprise-wide systems and services represent a class of COTS products and services that manage and control various classes of documents and data sets. In general, these systems and services need to be closely integrated with an enterprise relational data base management system through the use of application program interfaces (APIs). An advanced document management system, for example, is used to create and manage documents as collections of objects (e.g., text, graphics, and multimedia). These objects form part of the digital library that is managed by a relational data base management system.

The structured interviews identified several potential enterprise-wide systems and services. These systems and services include:

- **Workflow management.** NEMIS has used Viewstar for workflow services. However, the implementation has not been as successful as desired. Enterprise-wide automated workflow services integrated with a document management capability are typically needed in document-related and repetitive applications such as grant management and correspondence and action tracking. Workflow processes can also support repetitive mailroom services such as receipting, validation, and routing of documents, as well as print on-demand approaches for information dissemination. Enterprise-wide workflow services were a commonly cited requirement in the structured interviews and can be applied in repetitive business functions.

- **Geographical Information Systems (GIS).** Tighter integration of GIS with FEMA's business functions was cited by nearly every FEMA organizational element as being important to FEMA's mission. GIS systems provide specialized capability to manage and link geospatial data, as well as provide tools that lead to an increased understanding of the underlying geographical factors associated with FEMA's operations. Important objects in crisis management scenarios and mitigation activities can be geo-referenced, indexed, and searched within a GIS. See Figure 1-15 for the concept. From an IT perspective, the FEMA standard GIS products are MapInfo Professional and ARC/INFO. As the *FEMA IT Architecture* evolves and the network is enhanced with Quality of Service and improved bandwidth management provisions, the potential exists to make the FEMA enterprise-wide GIS be more accessible to FEMA's business partners, and to be much more interactive for very large and complex maps. As the GIS is better integrated with models and simulations, it will be better able to support mitigation, response and recovery, as well as preparedness, training, and exercises.

- **Document Management System (DMS).** In general, there are four classes of document management systems. These classes include:
  - DMSs that treat and manage documents as scanned images. These DMSs are frequently referred to as image management systems. Within the *FEMA IT Architecture*, this class of DMS is addressed in more detail below.
  - DMSs that treat documents as single unitary files such as word processing files with embedded images.
  - DMSs that treat documents as collections of discrete objects, but that manage the text stream as a single file with external links to objects such as graphics and multimedia.
  - DMSs that treat documents as collections of objects with links to external objects such as graphics and multimedia, and that manage the text stream as discrete elements with discrete tagging or markup using SGML, XML, or HTML. These DMSs can potentially treat individual elements such as paragraphs, chapters, titles, hyperlinks, tables, and even cells within a table as discrete, manageable objects. These types of DMSs are referred to as *fine-grained* DMSs and are most frequently employed in digital library systems. This class of DMS is recommended and is generally capable of handling unitary files and simpler object models of documents. From a commercial perspective, this class does not usually support image-based models of documents.

  A significant number of the structured interviews identified an enterprise-wide document management system as a potential need within FEMA. A document management system integrated with workflow, text search, the enterprise RDBMS, digital signature (if needed), display and rendering tools, office automation products, e-mail and messaging services, and scanning and conversion services forms the essential ingredients needed for development and

integration of: 1) correspondence and action tracking system, and 2) a grants management system. Within FEMA, the IRB has established a task force to generate more detailed requirements that will cover the Agency's needs in the combined areas of action tracking, correspondence control, and document management.

- **Image Management System (IMS).** In general, image management systems treat documents as scanned collections of pages. Within FEMA, image management is important because a significant number of documents are still received in paper format. IMSs have the advantage of preserving the *look and feel* of the original document, albeit as a facsimile. An image-based system also preserves any handwritten signature within the image. The major disadvantage of image-based DMSs are that the documents are not intrinsically searchable using text search tools without applying optical character recognition (OCR) techniques, which tend to be inaccurate and which must be quality controlled. Given the large volume of paper-based and facsimile documents that FEMA receives, the *FEMA IT Architecture* recommends incorporation of an IMS. The IMS should be integrated with scanning and conversion services within an electronic mailroom. The IMS also needs to be integrated with other elements of the digital library including: the enterprise RDBMS, the intelligent DMS, workflow services, and text search services (for OCRed documents).

- **Information Dissemination Services.** The structured interviews indicated that information dissemination is an important service for FEMA for mitigation support and for public notification during response and recovery operations. Information dissemination also supports preparedness and is needed in such areas as floodplain insurance for marketing purposes and fire administration for dissemination of fire incident reports and lessons learned. The *FEMA IT Architecture* recommends development of common information dissemination services as an enterprise-wide architectural component. The information dissemination services need to be fully integrated into the digital library services. Other integration should include: interface with Java-based Web interfaces that support streaming audio and video (push-pull technology), the RDBMS, the DMS and IMS, the data warehouse, workflow (for scheduled information dissemination releases), electronic mailroom and messaging services, groupware, and text search tools.

1.12.6.8 Bi-Directional Electronic Mailroom and Messaging Services

A key component of the proposed FEMA IT Architecture will be 24-hour per day and 7-day per week (24/7) support for bi-directional electronic mailroom and messaging services. These services will provide for the receipt, distribution, and dissemination of information including a broad scope of documents and data. Bi-directional electronic mailroom and messaging services are an essential element of correspondence and action tracking. This paragraph defines the major architectural components that are currently anticipated to be needed for an electronic mailroom and messaging services. As such, they provide a high-level architectural vision.

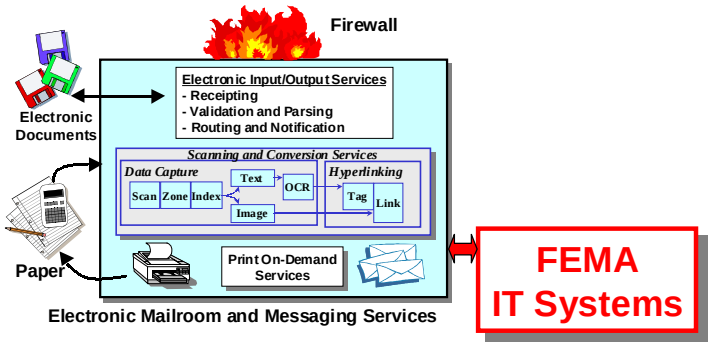
Within FEMA, the IRB has established a task force to review current systems including NEMIS, ACT, CIMS, and others, which either use and/or provide electronic mailroom services in support of correspondence and action tracking. The task force will generate and refine requirements covering Agency needs in the combined areas of action tracking, correspondence control, and document management. The group will also review processes (such as mailroom services) that are necessary to implement an enterprise-wide correspondence and action tracking system.

The products of the IRB task force will consist of a requirements document, a process document, and recommendations on software solutions. The ITS Directorate will provide support to the

group for reviewing existing products, specifically NEMIS and ACTS. The Directorate will also generate specific IT requirements, review other COTS software solutions, conduct cost-benefits analysis, and prepare life-cycle cost estimates. The Operations Support Directorate will provide the lead on process recommendations. The electronic mailroom and messaging services described below are intended to provide high-level architectural inputs to the IRB task force and are subject to further refinement.

➢ **Electronic Input/Output Services, Scanning and Conversion, and Print On-Demand Services**

The three major components of the 24/7 bi-directional electronic mailroom and messaging services include:

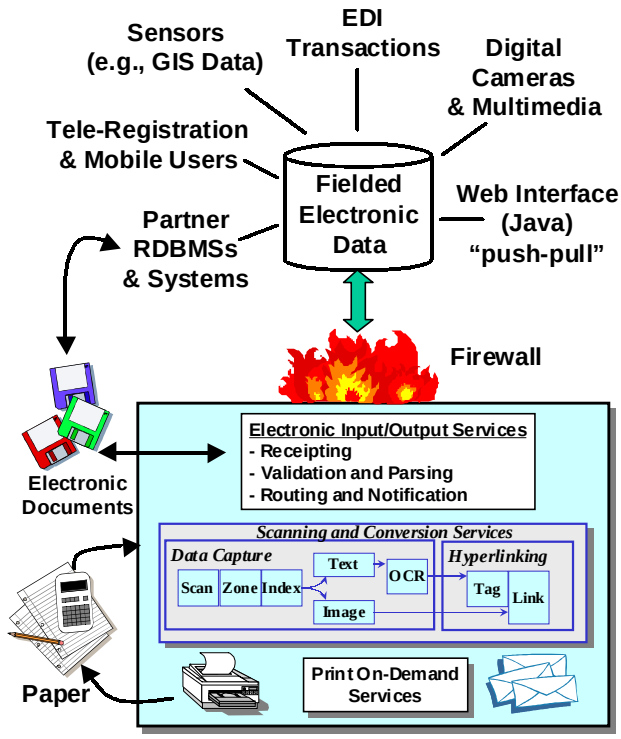


- **Electronic Input/Output Services.** The electronic receipt and dissemination of information under the *FEMA IT Architecture* includes basic services for processing structured electronic documents and fielded data. When an electronic document is received at the electronic mailroom, a receipt may be sent back to the document originator via e-mail or other electronic means to acknowledge the transaction. If the document is in a structured format such as SGML or XML, the document is parsed under software control to ensure that the document instance conforms to the document model it was created under. At this time, any external objects, such as graphics files, can be checked to ensure that they are readable. Once the document is validated, it is handed off to the document or image management system as appropriate for cataloging and check in. At this point, recipient is known, the workflow management system is invoked to route the document to the intended recipient. The Electronic I/O Services also support validation of fielded electronic data and messaging to authorized external users, customers, and the public through appropriate security measures and firewalls.

- **Scanning and Conversion Services.** Because documents received by FEMA will continue to be sent in paper format for the foreseeable future, the proposed technical architecture will include provisions for converting them into digital format. The first step in this process is the actual scanning of the document into an image-based format. From here, the document may take one of two paths. The first path is for documents that will be stored in image format. These documents are simply scanned and indexed before being routed into the image management system. A good example of this process is the current approach used in the Correspondence and Issues Management System (CIMS). The second, more complex path is used for documents that are to be converted into an intelligent format for later reuse. After the initial scanning to image format, these documents are processed by OCR software to recover the actual text and format of the document. At the same time, any graphical material is saved to an image format and linked to its location in the text stream. If the document is to be converted to a structured information format, as illustrated in Figure 1-15, (e.g., HTML or XML for Web-based delivery), autotagging software applies the necessary markup to the text file and links any graphic objects as separate files. From here, all documents are routed to either the image management or document management system, depending upon the format. The automated workflow component is then invoked to route the document to the proper place and to process repetitive events such as action tracking, grants management, etc.

- **Print On-Demand Services.** The final component of the digital mailroom is the print on-demand component. Print on-demand functionality allows users to create hardcopy for information dissemination purposes. As indicated in the Technical Reference Model (TRM), The FEMA standardized approach for print on-demand uses Xerox DocuTech and DocuColor. This function also supports such services as direct mail and marketing support (e.g., automated mailing list distribution of Federal Insurance Administration materials).

➢ **Support for Direct Bi-Directional Data Transfer of Fielded Electronic Data**



Electronic Mailroom and Messaging Services

As illustrated, with appropriate security and firewall provisions, the electronic mailroom and messaging services can provide an architectural framework and interface for bi-directional data transfer of fielded electronic data. The interchange of fielded electronic data is functionally different from the interchange of structured electronic documents in that the interchange can be under the direct control of a relational data base management system.

With appropriate wide-area security and firewall considerations addressed, examples of the use and interchange of fielded electronic data might include the following:

- **Web Interface (Java).** Java-based Web interfaces can be developed and integrated with information dissemination services and the digital library to support information *push-pull* concepts including streaming audio and video. The Java-based Web interface can also support distributed groupware applications such as distance learning, distributed planning, and intelligent collaboration and visualization. Java-based interfaces can also be developed to support mobile users and authoring and validation of documents such as grant applications.

- **Electronic Commerce (EDI and EFT Transactions).** Electronic Data Interchange (EDI) and Electronic Funds Transfer (EFT) are two classes of structured or fielded data interchange that can be handled within this architecture.

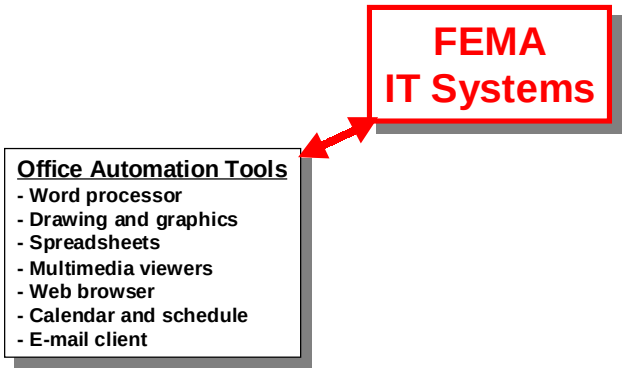
- **Tele-Registration, Mobile Users, and Information Kiosks.** When integrated as part of an IT system such as NEMIS, the Electronic Mailroom and Messaging services can directly support fielded data transfer as well as document transfer and digital library services to remote users. Tele-Registration is an excellent example of direct computer-to-computer fielded data transfer that is incorporated within NEMIS. With validation and messaging notification, the concept of direct fielded electronic data and document interchange can readily be extended to mobile users and information kiosks.

- **Systems for Sensory Data (e.g., for GIS applications), Digital Cameras, and Multimedia Capture Devices.** Many IT systems produce fielded or structured electronic data for sensors, digital cameras, and multimedia data capture devices. With appropriate security and firewall considerations, the electronic mailroom and messaging services can support a direct interface with these systems. With input and output validation services and receipting, the electronic mailroom can serve as a high-level architectural interface to receive and process GIS data from external sources. In that the fielded electronic data interface to systems is anticipated to be bi-directional, the potential exists within this high-level architecture to support advanced concepts such as telepresence and other collaborative techniques.

- **FEMA Business Partner RDBMSs and IT Systems.** With appropriate security and firewall provisions and with carefully crafted Memoranda of Agreement (MOAs), the high-level architecture for electronic mailroom and messaging services can support direct electronic document and data transfer with FEMA's business partners. Additional IT architectural work needs to be accomplished to design, develop, and implement networks such as Extranets and Virtual Private Networks (VPNs). Security technologies such as Kerberos token passing for originator authentication need to be more actively explored. Also, criteria will need to be developed to support receipting of information, validation and parsing of the data and documents, and routing to appropriate individuals and IT system. With the integration of groupware concepts such as intelligent collaboration and visualization and distance learning, it should be possible in the future to extend digital library concepts (including GIS data) to FEMA's business partners, as well as have FEMA be able to access data and documents within external systems. This extension will need to consider the potential impact on FEMA network bandwidth management.

1.12.6.9 Office Automation Tools

As illustrated, FEMA IT systems and users need to be able to exploit current and evolving office automation tools. Many of the documents and data sets that FEMA produces are appropriate for authoring using COTS office automation products such as MS Office 97, which is the FEMA standard office automation tool.



Within MS Office, file formats are acknowledged to be proprietary and require additional profiling to meet archival storage requirements.

Future needed office automation capability includes:

1. **Authoring of XML** (as an open systems replacement for HTML on the Web) consistent with the object-relational document model as shown in the Figure 1-15 data model. XML is expected to be in next release of MS Office. Other SGML and XML tools are widely available. Document Type Definitions (DTDs) and style sheets for structured documents need to be developed, standardized, and coordinated across the enterprise.

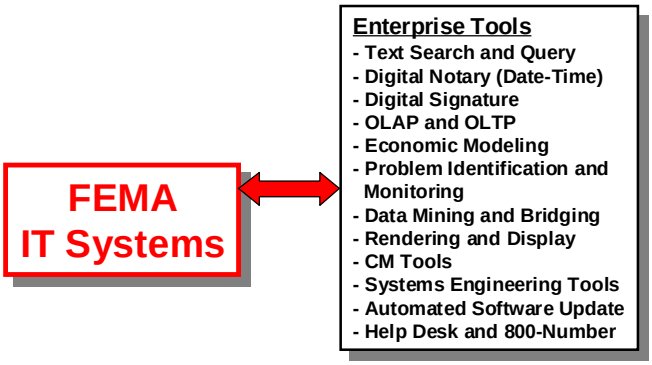
2. **Authoring, use, and enterprise-wide integration of electronic forms on the desktop.** Jetform Formflow is under consideration and evaluation by the Operations Support Directorate (OSD). Jetform is used by many other Federal agencies, thereby promoting interoperability. The proprietary file format needs to be profiled and defined to promote it to archival status.

Components of the current FEMA office automation tool kit include:

- Word processor (Word)
- Spreadsheet (Excel)
- Presentation graphics (Power Point)
- Desktop relational data base management (Access)
- E-mail client (Exchange Server and Outlook)
- Web browser and plug-ins (Internet Explorer)
- Web page authoring (Word augmented by FrontPage)
- Calendar tool (scheduling) (Schedule+)
- Contact manager (Schedule+ and Outlook)
- Task manager (simple) (Outlook)
- Journaling tool (Outlook)
- Windows environment (NT, Win 95/98)
- Multimedia playback (Media Player).

1.12.6.10 Enterprise-Wide Standard Tools

A key feature of the proposed *FEMA IT Architecture* illustrated in Figure 1-16 is the availability of enterprise-wide, standardized software tools working in a secure environment. These tools provide key capabilities for accessing, manipulating, managing, and using the broad range of information available in the FEMA IT environment. Each of these tools provides certain functionality in the IT architectural plan. NEMIS is addressing many of these tools.



The following list summarizes the major capabilities and requirements that were identified in the structured interview process:

- **Text Search and Query.** State-of-the-art text search tools allow users to identify and retrieve mission-critical information across heterogeneous data and document sources. Users can query the data collection in a distributed environment without knowing the actual data sources physical location. Queries can be constructed and stored for later use, or repetitive searching requirements. Queries themselves can be built upon key word indexing and query constructors (e.g., and, or, not etc.), fuzzy logic matching, and tailored indexes. Advanced searches can employ artificial intelligence techniques to find relevant information based upon semantic similarity. Periodic indexing of the data and document collection takes place as a background task in order to ensure rapid response as the data collection grows. NEMIS has utilized Oracle ConText as a text search tool. The requirement for an enterprise-wide

approach to text search and retrieval was among the most frequently cited requirements during the structured interview process.

- **Digital Notary.** An important concern for digital documents in a future electronic commerce environment is the need to ensure that unauthorized changes can not occur without detection. Digital notary services such as that provided by Surety Systems and other services such as secure board-level clocks from Datum, Inc. can provide this level of assurance. In the Surety model, the digital notary service generates a secure hash based upon the content of the document or file and combines this hash with other hashes received from other documents processed at the same time. The approach not only locks the content of the document, but also securely date-time stamps it. If the document or file is changed in any way, the digital time stamp no longer matches, and the document is flagged as altered by the notary service client software. The rolling time hash is published in a major periodical, as a form of public witnessing, further ensuring that no compromises can be made to the file content.

- **Digital Signatures**. The need for secure digital signatures was a commonly expressed requirement during the structured interview process, though there was some misunderstanding about a raster-scanned signature as being a digital signature. At an appropriate time, FEMA will consider enterprise-wide integration of digital signature services. The current concern is that digital signatures are not well integrated and supported as a widely implemented component of the electronic commerce infrastructure. A widely-recognized major concern is binding the public key of the sender of the information to the particular individual. Also, FEMA has concerns about standards and interoperability as well as cost. Nonetheless, in an electronic environment, in the absence of paper-based representations for documents, a reliable mechanism for representing signatures is required. In the digital environment, this mechanism must be able to authenticate a signer relative to a specific file or collection of files. Public key encryption provides this service by using a pair of unique digital keys. The first key is a private key used by the party signing the document. The second key is a public key known to the document recipient and bound to the sender via some recognized certificate authority. The private key is used to generate a unique hash file based upon the file content being sent and the key value itself. The signature hash file is then sent with the document file to the recipient. The public key is used by the recipient on the signature file to authenticate the sender and the file content. The digital signature approach can be combined with date-time stamping.

- **On-Line Analytical Processing (OLAP) and On-Line Transaction Processing (OLTP).** OLAP and OLTP are comparatively new services that are of interest to organizations such as OFM and FIA. These services provide users with advanced capabilities for search and information retrieval in the distributed computing environment. These processes act as intelligent agents that continually monitor the distributed data sources for information on a particular topic, such as losses or claims on a set of insurance policies. These processes work in the background without user intervention and report items of interest when they are found. This capability can be an extremely powerful tool for monitoring such things as information on a particular geographical region of the country, claims on an insurance policy, aggregated grant management performance results, a particular type of disaster, or a certain subject of interest.

- **Economic Modeling Tools**. Economic modeling tools will allow FEMA managers to better estimate costs by modeling financial data in a way that best represents the problem area. Flexibility built into these tools will allow alternatives to be compared and different scenarios

to be run to assess economic impact. Simulation capabilities will also allow causal relationships to be identified in the data that might otherwise remain undetected.

- **Problem Monitoring and Tracking Tools.** Within the target *FEMA IT Architecture*, there is a need for automated tools to help identify and track of events related to a particular problem or situation. Problem monitoring and tracking tools can be potentially standardized as common architectural components. These tools, combined with the OLAP and OLTP services previously mentioned, can potentially provide FEMA personnel with a reliable and up to date source of problem information. These tools can allow the users to gather, organize, sort, annotate and present information in a manner best dictated by the particular problem or situation. Information collected may come from a number of disparate sources, and in varying data formats. These tools will allow the users to collect, analyze, and use this information quickly and accurately.

- **Data Mining and Heterogeneous Data Base Bridging Tools**. The need for an enterprise-wide ability to support data mining and bridging of heterogeneous distributed data bases was expressed by a significant number of respondents during the structured interviews. Data mining tools are software that sifts the data and looks for new patterns, trends and relationships. In principle, they can be applied across internal and external data bases and are an important architectural component for digital library services. As the GIS data library grows, there is significant potential to apply data mining technology to support mitigation activity. Data mining can also be applied to identify trends in exercise results. Data base bridging is a technology to support queries and joins across heterogeneous data bases. Heterogeneous data base bridging tools basically accommodate unique syntactic and semantic differences in various data base vendor implementations of SQL. The tools are also useful in harmonizing differences in data dictionaries across various data base implementations.

- **Rendering and Display Tools.** Because the target *FEMA IT Architecture* will contain many different types and formats of information, tools must be provided for presenting the information in human-friendly terms. The IT toolkit will provide users with a number of rendering and display tools for this purpose. Standardized tools need to be developed or acquired to render textual, graphical, relational, and numerical data in a number of ways, depending upon the data type and the informational needs of the user. Particularly important will be the future need to develop standardized approaches for rendering multimedia and virtual reality (VR) representations in models and simulations (e.g., using Virtual Reality Modeling Language). Such multimedia and VR capabilities are already being developed and evaluated in the U.S. Fire Administration. From an enterprise-wide architectural component perspective, this class of tools will, to the extent practicable, be transparent to the user and be invoked under systems control when needed. Composition capabilities will need to be provided for output to paper and electronic formats including future XML-based Web pages for information dissemination purposes, as appropriate.

- **Configuration Management Tools.** An important class of tools in the *FEMA IT Architecture* will be responsible for maintaining control over configuration item components within FEMA IT systems and networks. As standards for data formats change, technology evolves, and IT and network systems evolve, the need for a disciplined and standardized approach for configuration management increases. Enterprise-wide CM tools will allow controlled management of user data sets, system software, hardware, and related architectural

components over time. The Technical Reference Model and Appendix N list enterprise-wide configuration management tools that have been adopted.

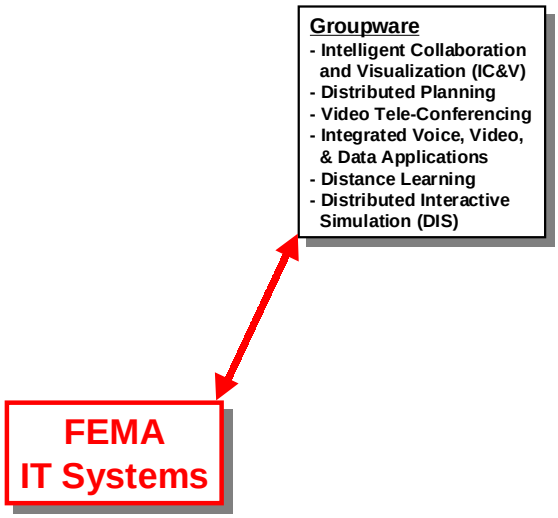
- **Systems Engineering Tools.** In order to develop and integrate robust and reliable architectural components for the *FEMA IT Architecture*, a set of powerful systems engineering and development tools is required. Computer-Aided Software Engineering (CASE) tools are intended to be a standardized architectural component. CASE tools will allow FEMA developers to develop accurate data and processing models for components of the IT infrastructure. Access to building blocks such as standardized data dictionary services, interfaces, and standard hardware/software/network components will ensure a high level of systems interoperability between the various components of the evolving *FEMA IT Architecture*.

- **Automated Software Update Tools.** As the components of the *FEMA IT Architecture* mature, and the underlying software components change, a mechanism will be required to ensure that system users are kept current in terms of software technology. A key component of the *FEMA IT Architecture* will be the automated software update function. This process will operate in the background and monitor user software configurations automatically. It will then provide updates and changes without user intervention. This process will help mitigate the complexities of change management in a distributed environment. See Appendix N for a list of automated software update tools.

- **Help Desk and 800-Number Services.** As the *FEMA IT Architecture* is implemented, new systems such as NEMIS come on-line, and future capabilities are designed and integrated, user support will be a critical component of the *FEMA IT Architecture*. User support will be provided in a number of ways, depending upon the technical area. Extensive use of on-line support and help systems will be provided to solve most common problems. Existing methods of providing hotline support within FEMA will be consolidated and harmonized. The Architecture also envisions some consolidation and re-use of the number of 800-number lines. A hotline to an IT support desk will allow users to contact IT professionals when problems occur that cannot be readily solved by other methods.

1.12.6.11 Groupware

In the *FEMA IT Architecture*, groupware includes a class of tools that support distributed operations and business functions requiring persons to interact with each other on documents and data sets. In general, groupware tools need to be integrated across the enterprise to gain seamless access to digital library services, integrated systems and services, enterprise-wide tools such as text search and rendering and display tools, and electronic mailroom services. In particular, an emerging technology trend for groupware is to utilize Java-based Web interfaces and Secure Socket Layer (SSL) services tools for collaboration.



In the structured discussions, groupware was a widely cited architectural need and requirement. Groupware can support operations and business

functions such as: 1) response and recovery where FEMA enterprise decision-makers are mutually sharing a digital map and comparing notes on objects that are geo-referenced on the map; 2) human services where an application has been filed and must be reviewed by a number of individuals who are distributed; 3) mitigation activity in sharing results of studies and analyses with distributed partners, the States, and Regions; and 4) training and exercise events involving distributed planning, reconstruction, analysis, and results dissemination.

The following briefly identifies the classes of tools and technologies that may be considered as groupware architectural components:

- **Intelligent Collaboration and Visualization (IC&V) Tools.** IC&V tools are considered an essential element of distributed digital library services. As the name implies, they facilitate collaboration and visualization of objects across the enterprise in an intelligent fashion. Through careful systems development and integration, IC&V tools are able to access and use other systems and services such as the relational data base management system, workflow processes, text search tools, and rendering tools (to name a few). What makes these tools intelligent is their rich and value-added ability to exploit advanced distributed digital library services in ways that are intuitive and user-friendly. IC&V tools typically support voice, video, and data applications, though these data streams may not be integrated into a single data stream such as an ATM protocol could support.

- **Distributed Planning Tools.** Distributed planning tools are a class of groupware that supports planning functions where an optimum plan or course of direction is desired. Generally speaking, these tools tend to drive the distributed planning team towards a particular solution where all of the major variables have been explored and evaluated. Distributed planning tools typically have a modeling and simulation component to support the evaluation. They typically also have an optimization component. When combined with a GIS, distributed planning tools represent a powerful technology for developing and evaluating potential courses of action in advance of having to commit to a real world operation.

- **Video Tele-Conferencing (VTC).** FEMA currently conducts video tele-conferencing over its backbone network. This VTC currently transmits voice and video. The current VTC does not directly integrate a data stream or data source. Also, the Quality of Service is not adaptive. VTC will continue to be a part of the target *FEMA IT Architecture*.

- **Integrated Voice, Video, and Data Applications.** Integrated voice video, and data applications were frequently mentioned in the structured interviews. In the target *FEMA IT Architecture*, these integrated applications provide intelligent collaboration and visualization services (IC&V) as above. The major difference is that integrated voice, video, and data applications are carried on a single data protocol (such as ATM). The data protocol provides adaptive Quality of Service (QoS) and some measures of security. Integrated voice, video, and data applications are currently the subject of considerable R&D in projects such as the Next Generation Internet (NGI) and Internet2. They also tend to be computationally and bandwidth intensive especially as they are integrated with very large distributed digital libraries containing large and complex objects. Interactive GIS is an example of a FEMA system that could benefit from such technology. As integrated voice, video, and data applications are developed, and as the FEMA network evolves, and as the business case warrants; FEMA will consider incorporating such advanced applications into the *FEMA IT Architecture*.

- **Distance Learning.** Distance learning was a widely cited technology in the structured discussions. Strong proponents included Mitigation, PT&E, R&R, Emergency Management Institute, and the National Fire Academy. As a groupware concept, distance learning technology is a form of intelligent collaboration and visualization that supports interactions between the instructor and students in a distributed environment. Distance learning exploits and uses digital library methods and allows for multimedia. Depending on the number of students and simultaneous users, as well as the size of the objects that are being interchanged, distance learning can be very bandwidth intensive. This technology also places a premium on the network to provide multicast capabilities and bandwidth management. Within the *FEMA IT Architecture*, the major value of distance learning is that it affords an opportunity to reach a potentially large number of distributed individuals without the hassle of travel and face-to-face meetings. Distance learning has some potential for achieving cost savings, which needs to be further analyzed.

  Currently within FEMA, distance learning is being afforded via the Emergency Education Network (EENET). EENET is a satellite-based distance learning system to bring interactive training programs into virtually any community nationwide. This system provides fire and emergency management training on a regularly scheduled basis through EENET's *National Alert* monthly broadcasts, as well as a variety of special videoconferences, training courses and town hall meetings. Schedules are updated periodically. All programming is open and is in the public domain. Any community with access to a C-band or Ku-band satellite dish, or a community cablevision provider, can receive the broadcast and participate in the training programs. In the target *FEMA IT Architecture*, EENET will continue to be used and exploited. Consistent with business case analysis, additional efforts will broaden the base of interactive distance learning using the Internet, the FEMA Intranet, and Extranets.

- **Distributed Interactive Simulation (DIS).** DIS is a protocol developed by the Department of Defense to support widely-distributed exercises and training events. It is in routine use in conducting realistic training across all Services (e.g., Army, Navy, and Air Force). Individuals in the PT&E and Mitigation Directorates expressed an interest in evaluating this type of technology to potentially support FEMA training exercises and events. DIS is a distributed object-oriented and model-based approach that interchanges messages among exercise participants. With DIS, there is a requirement for exercise participants to share common data models, for example, a GIS-based map that provides *ground truth*. At each participating site, IT systems must also run models to keep the scenario going. DIS basically provides the data transport protocol to share events and decisions that are reflected in updates to individual site's data bases and displays. For DOD, DIS has been demonstrated to be an effective method of providing realistic distributed training in an exercise environment. DIS concepts need further evaluation in the FEMA environment. In particular, the potential impact on FEMA networks and IT systems providing digital library services needs to be carefully assessed.